

Original article

Extremely preterm infants small for gestational age are at risk for motor impairment at 3 years corrected age

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Received 14 March 2015; received in revised form 9 May 2015; accepted 29 July 2015

Abstract

Background: Few studies have targeted psychomotor development and associated perinatal risk factors in Japanese very low birth weight (VLBW) infants who are severely small for gestational age (SGA).

Design/subjects: A single-center study was conducted in 104 Japanese VLBW infants who were born preterm, due to maternal, umbilical cord, or placental abnormalities, between 2000 and 2007. Psychomotor development as a developmental quotient (DQ) was assessed using the Kyoto Scale of Psychological Development at 3 years corrected age. Severely SGA was defined as birth weight or length below -2 standard deviation values of the mean values at the same gestation. VLBW infants were divided into 2 subgroups based on gestational age at birth: ≥ 28 weeks ($n = 64$) and < 28 weeks ($n = 40$). DQs of infants with severe SGA were compared with those of infants who were appropriate for gestational age (AGA). Factors associated with developmental disabilities in VLBW infants with severe SGA ($n = 23$) were determined.

Results: In the group born at ≥ 28 weeks gestation, infants with severe SGA had normal DQ values and did not significantly differ from those with AGA. However, in the group born at < 28 weeks gestation, severe SGA infants had significantly lower postural–motor DQ values than AGA infants. Gestational age < 28 weeks was an independent factor for low postural–motor DQ, regardless of the cause of severe SGA or pregnancy termination.

Conclusions: Extremely preterm newborns with severe SGA are at risk of motor developmental disability at age 3 years.

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Keywords: Developmental quotient; Japanese cohort; Kyoto Scale of Psychological Development; Psychomotor development; Small for gestational age; Very low birth weight infant

1. Introduction

In Japan, recent advances in perinatal management have led to an increase in the survival rate of very low birth weight (VLBW) infants with fetal growth restriction, which results in infants who are small for gestational age (SGA) after birth [1–3]. Although VLBW

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infants with SGA can be considered as a population at high risk for psychomotor developmental disabilities, no definite conclusion has yet been reached regarding an association between such infants and developmental disabilities. Sung et al. showed that VLBW infants with SGA developed developmental disabilities at 3 years of age more frequently than VLBW infants born appropriate for gestational age (AGA) [4]. It has been reported that VLBW infants with SGA are at greater risk than VLBW infants with AGA for cognitive and/or language developmental problems at 1.5 years or 4 years of age [5,6]. However, another study reported no significant difference in the frequency of developmental disabilities between VLBW infants with SGA and AGA at 2 years of age [7]. Possible reasons for these inconsistent findings may include differences among the studies in the definition used for SGA, enrollment criteria, methods of evaluating developmental outcome, and the age at which developmental outcome is assessed.

In the present study, to overcome these issues, we recruited infants with severe SGA who had a birth weight (BW) or length below -2 standard deviation (SD) values compared with the mean values at the same gestation. We reasoned that clearer results might be obtained with this definition than by using the standard definition of SGA, which is commonly designated as less than the 10th percentile. Only VLBW infants with severe SGA due to maternal, umbilical cord, or placental abnormalities were enrolled in the present study to exclude the influence of congenital abnormalities and chromosomal diseases. We assessed developmental disability using the Kyoto Scale of Psychological Development (KSPD) at 3 years corrected age, which is the most commonly used method for the determination of developmental outcomes for VLBW infants in Japan [5,8–11].

The purposes of the present study were to determine whether Japanese VLBW infants with severe SGA are at risk of psychomotor developmental disabilities at 3 years corrected age compared with VLBW infants with AGA. Furthermore, we aimed to determine factors associated with developmental disabilities in Japanese VLBW infants with severe SGA.

2. Patients and methods

2.1. Study design and patients

For this retrospective study, we reviewed the medical charts of VLBW infants born preterm due to maternal, umbilical cord, or placental abnormalities in Kobe University Hospital between 2000 and 2007. We then evaluated psychomotor development at 3 years corrected age. This study was approved by the ethics committee of Kobe University Graduate School of Medicine (#1438).

One hundred and four VLBW infants were included. First, the infants were divided into 2 subgroups based on gestational age at birth: ≥ 28 weeks ($n = 64$) and < 28 weeks ($n = 40$). We recorded clinical background characteristics and developmental quotients (DQs) in three areas: postural–motor (P–M), cognitive–adaptive (C–A), and language–social (L–S), as well as an overall DQ. We compared clinical characteristics and DQs in infants with severe SGA with those in infants with AGA. Second, we investigated the causes of development of severe SGA and of termination of pregnancy ($n = 23$). Third, factors associated with developmental disability in VLBW infants with severe SGA were determined using univariate and multivariate logistic regression analyses. Finally, the cut-off value associated with a particular developmental disability was determined.

2.2. Assessment for psychomotor development

Psychomotor development, including P–M, C–A, and L–S subscales, was assessed as a DQ using the KSPD at 3 years corrected age (median: 36 months corrected age, range: 33–39 months corrected age). The normal range for DQ was allocated as 80–110. To rank our cohort, the distribution of the number of infants classified by DQ (< 70 , between 70 and 85, ≥ 85) was compared with that in the Japanese NICU-network database [10].

2.3. Definitions of AGA, SGA, and severe SGA

AGA, SGA, and severe SGA were defined as BW or birth length above the 10th percentile (-1.28 SD), between the 10th percentile (-1.28 SD) and -2 SD from the mean, and below -2 SD of the mean value at the same gestational age, respectively [12].

2.4. Neurological examinations

All VLBW infants were admitted to our neonatal intensive care unit (NICU) and received a daily physical examination by a neonatologist, including assessment for the presence of neonatal seizures. Each infant underwent daily fontanellar ultrasound examinations for the first 5 days after birth, and at least once a week thereafter. Brain magnetic resonance imaging (MRI) was performed in all infants at the time of discharge from NICU (around 40 weeks corrected gestational age). Electroencephalography (EEG) was performed at the discretion of the attending neonatologist, depending on the condition of the patient.

After discharge from NICU, infants were regularly followed up with medical and developmental check-ups by pediatricians or pediatric neurologists at Kobe University Hospital. Infants with a change of address after discharge were not followed up in this

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